

**UTILITY PATENT APPLICATION TRANSMITTAL**  
**(Large Entity)***(Only for new nonprovisional applications under 37 CFR 1.53(b))*Docket No.  
2204/184Total Pages in this Submission  
31**TO THE ASSISTANT COMMISSIONER FOR PATENTS**Box Patent Application  
Washington, D.C. 20231

Transmitted herewith for filing under 35 U.S.C. 111(a) and 37 C.F.R. 1.53(b) is a new utility patent application for an invention entitled:

**SYSTEM, DEVICE, AND METHOD FOR DISTRIBUTING LINK STATE INFORMATION IN A COMMUNICATION NETWORK**

and invented by:

**Bradley Cain**If a **CONTINUATION APPLICATION**, check appropriate box and supply the requisite information:☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No.: \_\_\_\_\_

Which is a:

☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No.: \_\_\_\_\_

Which is a:

☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No.: \_\_\_\_\_

Enclosed are:

**Application Elements**

1. ☐ Filing fee as calculated and transmitted as described below
2. ☒ Specification having 18 pages and including the following:
  - a. ☒ Descriptive Title of the Invention
  - b. ☐ Cross References to Related Applications *(if applicable)*
  - c. ☐ Statement Regarding Federally-sponsored Research/Development *(if applicable)*
  - d. ☐ Reference to Microfiche Appendix *(if applicable)*
  - e. ☒ Background of the Invention
  - f. ☒ Brief Summary of the Invention
  - g. ☒ Brief Description of the Drawings *(if drawings filed)*
  - h. ☒ Detailed Description
  - i. ☒ Claim(s) as Classified Below
  - j. ☒ Abstract of the Disclosure

# UTILITY PATENT APPLICATION TRANSMITTAL (Large Entity)

(Only for new nonprovisional applications under 37 CFR 1.53(b))

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31

## Application Elements (Continued)

3. ☒ Drawing(s) (when necessary as prescribed by 35 USC 113)
- a. ☐ Formal Number of Sheets \_\_\_\_\_
- b. ☒ Informal Number of Sheets 5
4. ☒ Oath or Declaration
- a. ☐ Newly executed (original or copy) ☒ Unexecuted
- b. ☐ Copy from a prior application (37 CFR 1.63(d)) (for continuation/divisional application only)
- c. ☒ With Power of Attorney ☐ Without Power of Attorney
- d. ☐ DELETION OF INVENTOR(S)  
Signed statement attached deleting inventor(s) named in the prior application,  
see 37 C.F.R. 1.63(d)(2) and 1.33(b).
5. ☐ Incorporation By Reference (usable if Box 4b is checked)  
The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.
6. ☐ Computer Program in Microfiche (Appendix)
7. ☐ Nucleotide and/or Amino Acid Sequence Submission (if applicable, all must be included)
- a. ☐ Paper Copy
- b. ☐ Computer Readable Copy (identical to computer copy)
- c. ☐ Statement Verifying Identical Paper and Computer Readable Copy

## Accompanying Application Parts

8. ☐ Assignment Papers (cover sheet & document(s))
9. ☐ 37 CFR 3.73(B) Statement (when there is an assignee)
10. ☐ English Translation Document (if applicable)
11. ☐ Information Disclosure Statement/PTO-1449 ☐ Copies of IDS Citations
12. ☐ Preliminary Amendment
13. ☒ Acknowledgment postcard
14. ☒ Certificate of Mailing
- ☐ First Class ☒ Express Mail (Specify Label No.): EL442683377US

**UTILITY PATENT APPLICATION TRANSMITTAL**  
**(Large Entity)**

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31

**Accompanying Application Parts (Continued)**

15. ☐ Certified Copy of Priority Document(s) *(if foreign priority is claimed)*

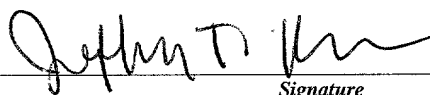
16. ☐ Additional Enclosures *(please identify below):*

**Fee Calculation and Transmittal**

**CLAIMS AS FILED**

For	#Filed	#Allowed	#Extra	Rate	Fee
Total Claims	31	- 20 =	11	x \$18.00	\$198.00
Indep. Claims	6	- 3 =	3	x \$78.00	\$234.00
Multiple Dependent Claims (check if applicable) <input type="checkbox"/>					\$0.00
BASIC FEE					\$760.00
OTHER FEE <i>(specify purpose)</i>					\$0.00
TOTAL FILING FEE					\$1,192.00

- ☐ A check in the amount of \_\_\_\_\_ to cover the filing fee is enclosed.
- ☐ The Commissioner is hereby authorized to charge and credit Deposit Account No. \_\_\_\_\_ as described below. A duplicate copy of this sheet is enclosed.
- ☐ Charge the amount of \_\_\_\_\_ as filing fee.
- ☐ Credit any overpayment.
- ☐ Charge any additional filing fees required under 37 C.F.R. 1.16 and 1.17.
- ☐ Charge the issue fee set in 37 C.F.R. 1.18 at the mailing of the Notice of Allowance, pursuant to 37 C.F.R. 1.311(b).

  
Signature

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Dated: December 7, 1999

CC:

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICATION FOR UNITED STATES PATENT

FOR

**SYSTEM, DEVICE, AND METHOD FOR DISTRIBUTING  
LINK STATE INFORMATION IN A COMMUNICATION NETWORK**

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## **SYSTEM, DEVICE, AND METHOD FOR DISTRIBUTING LINK STATE INFORMATION IN A COMMUNICATION NETWORK**

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### **FIELD OF THE INVENTION**

The present invention relates generally to communication systems, and more particularly to distributing link state information in a communication system.

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### **BACKGROUND OF THE INVENTION**

In today's information age, communication networks are often used for interconnecting computers and computer peripherals. A communication network typically includes a number of nodes that interoperate to route protocol messages. The various nodes in the communication network utilize various routing protocols in order to determine the routes that are used to route the protocol messages.

One type of routing protocol, known as a "link state" routing protocol, determines routes based upon the status of communication links between the various nodes. A link state routing protocol, such as the Open Shortest Path First (OSPF) routing protocol, requires each node to have complete topology information. Each node maintains a topology database that indicates all nodes in the communication network and lists the communication links that are associated with each node.

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The various nodes in the communication network exchange link state information using link state advertisement (LSA) protocol messages. Link state information is exchanged at various times. In particular, when a node is initialized, the node needs to obtain link state information in order to determine routes for routing protocol messages, and therefore the node's neighbors send LSA protocol messages to the node in order to provide the node with the necessary link state information. Also, each node periodically tests the communication links to each of its neighbors and sends a LSA protocol message including the link status information to all of the other nodes. When a failure occurs in the communication network (such as a communication link failure or a node failure), the

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various nodes in the communication network need to obtain updated link state information in order to determine new routes for routing protocol messages around the failure, and therefore the nodes adjacent to the failure send LSA protocol messages to the other nodes in the communication network in order to inform all nodes of the failure. Each node  
5 computes the routes based upon the link status information received from the other nodes.

Any time link state information is exchanged, it is desirable for the link state information to be distributed quickly in order for the receiving node(s) to determine new routes for routing protocol messages. Unfortunately, routing protocols utilize a "stop-and-wait" mechanism for distributing link state information. When a node sends an LSA protocol message to a neighbor, the node waits for an acknowledgment from the neighbor before sending another LSA protocol message. This is a very simple but inefficient way to distribute link state information.

An efficient technique for distributing link state information is needed.

## **SUMMARY OF THE INVENTION**

In accordance with one aspect of the invention, a link state routing protocol utilizes a sliding window mechanism to efficiently distribute link state information. The sliding window mechanism permits a predetermined number of unacknowledged link state advertisement protocol messages to be outstanding at any given time. Unacknowledged link state advertisement protocol messages are retransmitted after a predetermined timeout period.

## **BRIEF DESCRIPTION OF THE DRAWINGS**

The foregoing and other objects and advantages of the invention will be appreciated more fully from the following further description thereof with reference to the accompanying drawings wherein:  
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FIG. 1 is a block diagram showing an exemplary communication network in accordance with an embodiment of the invention;

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FIG. 2 is a block diagram depicting a series of LSA protocol messages in accordance with an embodiment of the invention;

FIG. 3 is a message flow diagram depicting an LSA protocol message exchange by a link state routing protocol using a "stop-and-wait" mechanism as known in the art;

FIG. 4 is a message flow diagram depicting an LSA protocol message exchange by a link state routing protocol using a sliding window mechanism in accordance with an embodiment of the invention;

FIG. 5 is a block diagram depicting a sliding window in a first position during an LSA protocol message exchange in accordance with an embodiment of the invention;

FIG. 6 is a block diagram depicting a sliding window in a second position during an LSA protocol message exchange in accordance with an embodiment of the invention; and

FIG. 7 is a block diagram depicting a sliding window in a third position during an LSA protocol message exchange in accordance with an embodiment of the invention.

### DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

An exemplary embodiment of the present invention uses a sliding window mechanism for distributing link state information. A sliding window mechanism permits a node to send multiple protocol messages without waiting for individual acknowledgments. The node can therefore have multiple unacknowledged protocol messages outstanding at any given time. The number of unacknowledged protocol messages that are permitted to be outstanding is referred to as a "window size." A typical embodiment might use a window size of eight (8) or 128, although the window size may be set to other values and may be set based upon network characteristics (such as round trip delay to a neighbor) or other considerations. It should be noted that a window size of one (1) degenerates to a "stop-and-wait" mechanism. The neighbor may acknowledge protocol messages one at a time, or may acknowledge multiple protocol messages together. Unacknowledged protocol messages may be retransmitted after a predetermined timeout period.

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In an exemplary embodiment of the present invention, a node is permitted to have a predetermined number of unacknowledged LSA protocol messages outstanding at any time. Thus, when the node needs to send link state information to a neighbor, the node is permitted to send multiple LSA protocol messages without waiting for individual  
5 acknowledgments for each LSA protocol message. The window size may be sufficient for the node to send all LSA protocol messages that it needs to send to the neighbor. However, assuming the node needs to send more LSA protocol messages than the window size allows, the node stops sending LSA protocol messages if and when the maximum number of unacknowledged outstanding LSA protocol messages is reached. The window size is preferably set so that, as long as there are no communication errors, the neighbor will acknowledge the LSA protocol messages quickly enough that the node does not have to stop sending LSA protocol messages. If a communication error occurs, the node may retransmit any unacknowledged LSA protocol messages.

There are many types of sliding window mechanisms, and an embodiment of the present invention may employ any applicable sliding window mechanism. The present invention is in no way limited to the type of sliding window mechanism employed.

In an exemplary sliding window mechanism, the node inserts a sequence number in each LSA protocol message. The sequence numbers typically start at zero (0) and increment to the window size minus one (1) before wrapping back to zero (0). In other  
20 words, the sequence number is modulo N, where N is the window size. The neighbor may be required to acknowledge each individual LSA protocol message, for example, by sending the sequence number of the LSA protocol message being acknowledged, or the neighbor may be permitted to acknowledge multiple consecutive LSA protocol messages, for example, by sending the sequence number of the last LSA protocol message in the  
25 sequence of LSA protocol messages being acknowledged. The neighbor may or may not be permitted to acknowledge LSA protocol messages received out of sequence or received after a dropped or missing LSA protocol message. Various retransmission techniques require the node to save unacknowledged LSA protocol messages in case the node needs to retransmit one or more LSA protocol messages. The node may be required to retransmit



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all LSA protocol messages following an unacknowledged LSA protocol message, or may be permitted to retransmit individual unacknowledged LSA protocol messages.

FIG. 1 is a block diagram showing an exemplary communication network 100 in accordance with an embodiment of the invention. The communication network 100 includes, among other things, a node 102 and a neighbor 106 coupled over a communication link 104. The node 102 and the neighbor 106 interoperate to route protocol messages within the communication network 100. Specifically, the node 102 and the neighbor 106 implement a link state routing protocol for determining routes within the communication network 100.

Implementation of the link state routing protocol requires the node 102 and the neighbor 106 to exchange LSA protocol messages over the communication link 104. During a particular LSA protocol message exchange, the node 102 may need to send multiple LSA protocol messages to the neighbor 106 over the communication link 104. FIG. 2 depicts a series of eleven (11) protocol messages 200 to be sent by the node 102 to the neighbor 106 over the communication link 104.

In a prior art embodiment, the node 102 sends the series of LSA protocol messages 200 to the neighbor 106 over the communication link 104 using a "stop-and-wait" mechanism. FIG. 3 is a message flow diagram depicting an LSA protocol message exchange by a link state routing protocol using a "stop-and-wait" mechanism. The node 102 sends one LSA protocol message at a time to the neighbor 106, and waits for an acknowledgment from the neighbor 106 before sending another LSA protocol message to the neighbor 106. Thus, the node 102 sends the first LSA protocol message 302 to the neighbor 106, and waits for an acknowledgment from the neighbor 106. Upon receiving the acknowledgment 304 from the neighbor 106, the node 102 sends the second LSA protocol message 306 to the neighbor 106, and waits for an acknowledgment from the neighbor 106. Upon receiving the acknowledgment 308 from the neighbor 106, the node 102 proceeds to send subsequent LSA protocol messages (not shown) in the same manner, until all LSA protocol messages have been sent and acknowledged.

In an exemplary embodiment of the invention, the node 102 sends the series of LSA protocol messages 200 to the neighbor 106 over the communication link 104 using a

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sliding window mechanism. FIG. 4 is a message flow diagram depicting an LSA protocol message exchange by a link state routing protocol using a sliding window mechanism using a window size of eight (8). The node 102 is permitted to have up to eight (8) unacknowledged LSA protocol messages outstanding at any given time. Thus, the node 102 may send the first eight (8) LSA protocol messages (402, 404, 406, 408, 410, 412, 414, 416) to the neighbor 106 before the node 102 must stop to wait for an acknowledgment from the neighbor 106 for at least one of the LSA protocol messages. At this point, there are eight (8) unacknowledged LSA protocol messages outstanding, specifically the LSA protocol messages (402, 404, 406, 408, 410, 412, 414, 416). FIG. 5 depicts the position of the sliding window 502 after the node 102 sends the first eight (8) LSA protocol messages to the neighbor 106.

Upon receiving an acknowledgment 418 for the first LSA protocol message 402 from the neighbor 106, the node 102 sends the ninth LSA protocol message 420 to the neighbor 106. At this point, there are eight (8) unacknowledged LSA protocol messages outstanding, specifically the LSA protocol messages (404, 406, 408, 410, 412, 414, 416, 420). FIG. 6 depicts the position of the sliding window 602 after the node 102 sends the ninth LSA protocol message 420 to the neighbor 106.

Upon receiving an acknowledgment 422 for the second and third LSA protocol messages (404, 406) from the neighbor 106, the node 102 sends the tenth and eleventh LSA protocol messages (424, 426) to the neighbor 106. At this point, there are eight (8) unacknowledged LSA protocol messages outstanding, specifically the LSA protocol messages (408, 410, 412, 414, 416, 420, 424, 426). FIG. 7 depicts the position of the sliding window 702 after the node 102 sends the tenth and eleventh LSA protocol messages (424, 426) to the neighbor 106.

In actuality, the neighbor 106 typically sends acknowledgments as it receives and processes the LSA protocol messages. The neighbor 106 may acknowledge each LSA protocol message individually, or, as with the acknowledgment 422 shown in FIG. 4, the neighbor 106 may acknowledge multiple LSA protocol messages simultaneously. Thus, the node 102 typically receives one or more acknowledgment messages from the neighbor 106 before reaching the maximum number of outstanding unacknowledged LSA protocol

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messages, and therefore the node 102 generally does not have to stop sending LSA protocol messages in order to wait for acknowledgment messages from the neighbor 106.

In the course of the LSA protocol message exchange between the node 102 and the neighbor 106, it is possible for certain protocol messages to be lost. This may be due to a communication error on the communication link 104 or other reason. Protocol messages may be lost in either direction. For example, the neighbor 106 may not receive one or more LSA protocol messages sent by the node 102, in which case the neighbor does not acknowledge the lost LSA protocol message(s). Also, the node 102 may not receive one or more acknowledgment messages sent by the neighbor 106. In either case, the node 102 detects the error condition by failing to receive an acknowledgment message for a particular LSA protocol message within a predetermined timeout period. The node 102 preferably retransmits unacknowledged LSA protocol messages after a predetermined timeout period. The node 102 may retransmit only specific unacknowledged LSA protocol messages, although it is more typical for the node 102 to retransmit all LSA protocol messages from the unacknowledged LSA protocol message onward. Thus, assuming the LSA protocol messages (408, 410, 412, 414, 416, 420, 424, 426) are outstanding, as depicted by the sliding window 702 as shown in FIG. 7, and the LSA protocol message 408 is unacknowledged, then the node 102 typically retransmits the LSA protocol messages (408, 410, 412, 414, 416, 420, 424, 426). This is true even if the neighbor 106 received some or all of the LSA protocol messages after the LSA protocol message 408.

In various embodiments of the invention, the sliding window mechanism may be integrated with an existing link state routing protocol, such as OSPF, or may be used in a new link state routing protocol. The present invention is in no way limited to a specific link state routing protocol.

In an exemplary embodiment of the present invention, predominantly all of the routing protocol logic including the sliding window logic is implemented as a set of computer program instructions that are stored in a computer readable medium and executed by an embedded microprocessor system within a node. Various embodiments of the invention may be implemented in any conventional computer programming language. For example, an embodiment may be implemented in a procedural programming language

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(*e.g.*, "C") or an object oriented programming language (*e.g.*, "C++"). Alternative embodiments of the invention may be implemented using discrete components, integrated circuitry, programmable logic used in conjunction with a programmable logic device such as a Field Programmable Gate Array (FPGA) or microprocessor, or any other means including any combination thereof.

Alternative embodiments of the invention may be implemented as a computer program product for use with a computer system. Such implementation may include a series of computer instructions fixed either on a tangible medium, such as a computer readable media (*e.g.*, a diskette, CD-ROM, ROM, or fixed disk), or fixed in a computer data signal embodied in a carrier wave that is transmittable to a computer system via a modem or other interface device, such as a communications adapter connected to a network over a medium. The medium may be either a tangible medium (*e.g.*, optical or analog communications lines) or a medium implemented with wireless techniques (*e.g.*, microwave, infrared or other transmission techniques). The series of computer instructions embodies all or part of the functionality previously described herein with respect to the system. Those skilled in the art should appreciate that such computer instructions can be written in a number of programming languages for use with many computer architectures or operating systems. Furthermore, such instructions may be stored in any memory device, such as semiconductor, magnetic, optical or other memory devices, and may be transmitted using any communications technology, such as optical, infrared, microwave, or other transmission technologies. It is expected that such a computer program product may be distributed as a removable medium with accompanying printed or electronic documentation (*e.g.*, shrink wrapped software), preloaded with a computer system (*e.g.*, on system ROM or fixed disk), or distributed from a server or electronic bulletin board over the network (*e.g.*, the Internet or World Wide Web).

The present invention may be embodied in other specific forms without departing from the essence or essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not restrictive.

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I claim:

1. A method for distributing link state information by a node to a neighbor in a communication system, the method comprising:  
5        sending a first link state advertisement protocol message to the neighbor; and  
         sending a second link state advertisement protocol message to the neighbor prior to receiving an acknowledgment message from the neighbor for the first link state advertisement protocol message.
- 10    2. The method of claim 1, further comprising:  
         monitoring for an acknowledgment message from the neighbor for the first link state advertisement protocol message;  
         failing to receive the acknowledgment message from the neighbor for the first link state advertisement protocol message within a predetermined timeout period; and  
15        retransmitting the first link state advertisement protocol message.
3. The method of claim 2, further comprising:  
         retransmitting the second link state advertisement protocol message.

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4. A method for distributing link state information by a node to a neighbor in a communication system, the method comprising:

maintaining a sliding window for sending up to a predetermined maximum number of link state advertisement protocol messages to the neighbor, wherein the predetermined maximum number is greater than one;

sending the predetermined maximum number of link state advertisement protocol messages to the neighbor; and

waiting for an acknowledgment message from the neighbor for at least one of the link state advertisement protocol messages before sending another link state advertisement protocol message.

5. The method of claim 4, further comprising:

receiving the acknowledgment message from the neighbor for a first link state advertisement protocol message; and

sending at least one more link state advertisement protocol message.

6. The method of claim 4, further comprising:

failing to receive the acknowledgment message from the neighbor within a predetermined timeout period; and

retransmitting at least a first unacknowledged link state advertisement protocol message.

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7. A device for distributing link state information in a communication network, the device comprising a link state routing protocol having a sliding window mechanism with a window size greater than one (1) for sending up to a predetermined maximum number of link state advertisement protocol messages without receiving an acknowledgment for any of said link state advertisement protocol messages.

8. The device of claim 7, wherein the link state routing protocol comprises:  
link state distribution logic operably coupled to generate link state advertisement protocol messages; and

sliding window logic responsive to the link state distribution logic and operably coupled to maintain a sliding window for sending up to a predetermined maximum number of link state advertisement protocol messages to the neighbor without receiving an acknowledgment for any of said link state advertisement protocol messages.

9. The device of claim 8, wherein the sliding window logic is operably coupled to send a first link state advertisement protocol message to the neighbor and to send a second link state advertisement protocol message to the neighbor prior to receiving an acknowledgment message from the neighbor for the first link state advertisement protocol message.

10. The device of claim 9, wherein the sliding window logic is operably coupled to monitor for an acknowledgment message from the neighbor for the first link state advertisement protocol message and to retransmit the first link state advertisement protocol message upon failing to receive the acknowledgment message from the neighbor for the first link state advertisement protocol message within a predetermined timeout period.

11. The device of claim 10, wherein the sliding window logic is operably coupled to retransmit the second link state advertisement protocol message.





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15. A program product comprising a computer readable medium having embodied therein a computer program for distributing link state information in a communication network, the computer program comprising a link state routing protocol having a sliding window mechanism with a window size greater than one (1) for sending up to a  
5 predetermined maximum number of link state advertisement protocol messages without receiving an acknowledgment for any of said link state advertisement protocol messages.

16. The program product of claim 15, wherein the link state routing protocol comprises:

10 link state distribution logic programmed to generate link state advertisement protocol messages; and

15 sliding window logic responsive to the link state distribution logic and programmed to maintain a sliding window for sending up to a predetermined maximum number of link state advertisement protocol messages to the neighbor without receiving an acknowledgment for any of said link state advertisement protocol messages.

20 17. The program product of claim 16, wherein the sliding window logic is programmed to send a first link state advertisement protocol message to the neighbor and to send a second link state advertisement protocol message to the neighbor prior to receiving an acknowledgment message from the neighbor for the first link state advertisement protocol message.

25 18. The program product of claim 17, wherein the sliding window logic is programmed to monitor for an acknowledgment message from the neighbor for the first link state advertisement protocol message and to retransmit the first link state advertisement protocol message upon failing to receive the acknowledgment message from the neighbor for the first link state advertisement protocol message within a predetermined timeout period.

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19. The program product of claim 18, wherein the sliding window logic is programmed to retransmit the second link state advertisement protocol message.

20. The program product of claim 16, wherein the sliding window logic is programmed to send the predetermined maximum number of link state advertisement protocol messages to the neighbor and to wait for an acknowledgment message from the neighbor for at least one of the link state advertisement protocol messages before sending another link state advertisement protocol message.

21. The program product of claim 20, wherein the sliding window logic is programmed to receive the acknowledgment message from the neighbor for a first link state advertisement protocol message and to send another link state advertisement protocol message.

22. The program product of claim 20, wherein the sliding window logic is programmed to retransmit at least a first unacknowledged link state advertisement protocol message upon failing to receive the acknowledgment message from the neighbor within a predetermined timeout period.

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23. A communication system comprising a node in communication with a neighbor,  
wherein the node includes a link state routing protocol having a sliding window  
mechanism with a window size greater than one (1) for sending up to a predetermined  
maximum number of link state advertisement protocol messages to the neighbor without  
receiving an acknowledgment for any of said link state advertisement protocol messages  
from the neighbor.

24. The communication system of claim 23, wherein the node is operably coupled to  
send a first link state advertisement protocol message to the neighbor and to send a second  
link state advertisement protocol message to the neighbor prior to receiving an  
acknowledgment message from the neighbor for the first link state advertisement protocol  
message.

25. The communication system of claim 24, wherein the node is operably coupled to  
monitor for an acknowledgment message from the neighbor for the first link state  
advertisement protocol message and to retransmit the first link state advertisement  
protocol message upon failing to receive the acknowledgment message from the neighbor  
for the first link state advertisement protocol message within a predetermined timeout  
period.

26. The communication system of claim 25, wherein the node is operably coupled to  
retransmit the second link state advertisement protocol message.

27. The communication system of claim 23, wherein the node is operably coupled to  
maintain a sliding window for sending up to a predetermined maximum number of link  
state advertisement protocol messages to the neighbor, to send the predetermined  
maximum number of link state advertisement protocol messages to the neighbor, and to  
wait for an acknowledgment message from the neighbor for at least one of the link state  
advertisement protocol messages before sending another link state advertisement protocol  
message.

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28. The communication system of claim 27, wherein the node is operably coupled to receive the acknowledgment message from the neighbor for a first link state advertisement protocol message and to send another link state advertisement protocol message.

5 29. The communication system of claim 27, wherein the node is operably coupled to retransmit at least a first unacknowledged link state advertisement protocol message upon failing to receive the acknowledgment message from the neighbor within a predetermined timeout period.

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30. A link state routing protocol comprising a sliding window mechanism.
31. The link state routing protocol of claim 30, comprising open shortest path first (OSPF) routing protocol logic in combination with the sliding window mechanism.

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### ABSTRACT OF THE DISCLOSURE

5 A system, device, and method for distributing link state information in a communication network combines a link state routing protocol with a sliding window mechanism in order to efficiently distribute link state information. The sliding window mechanism permits a predetermined number of unacknowledged link state advertisement protocol messages to be outstanding at any given time. Unacknowledged link state advertisement protocol messages are retransmitted after a predetermined timeout period.

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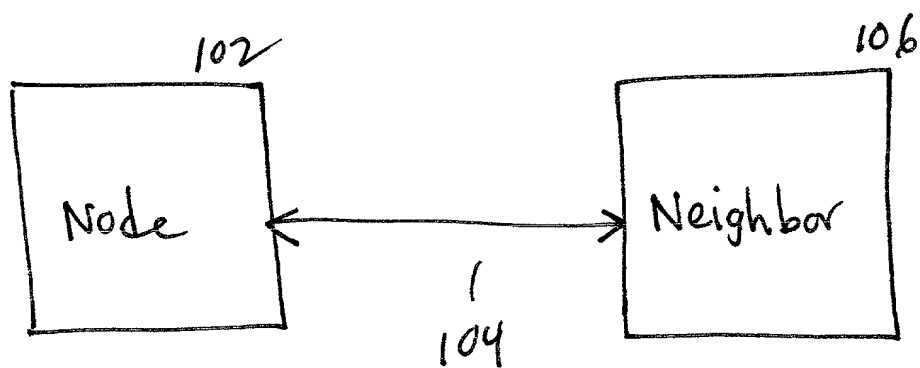


FIG. 1 100

1	2	3	4	5	6	7	8	9	10	11
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FIG. 2      200



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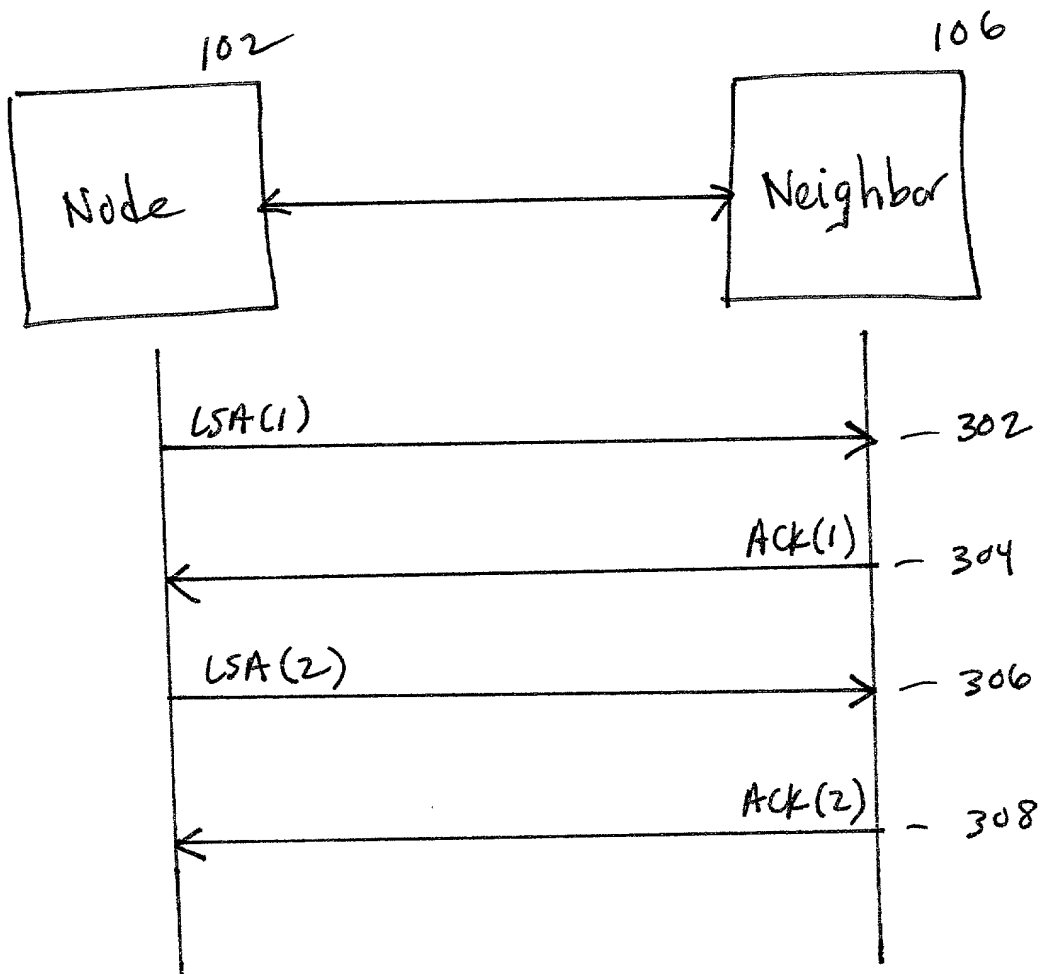


FIG. 3 300

PRIOR ART

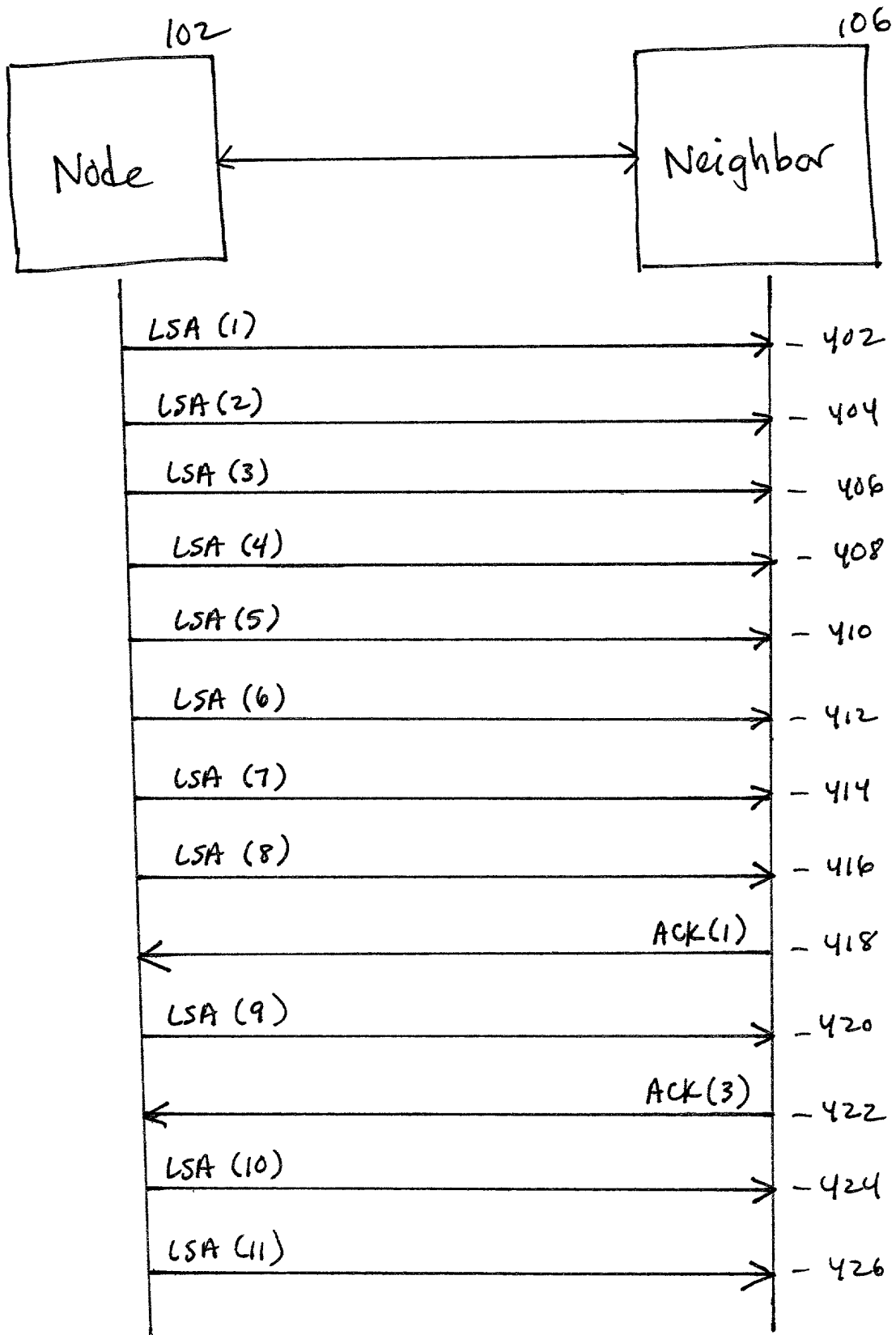


FIG. 4 400

— 502

1	2	3	4	5	6	7	8	9	10	11
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FIG. 5 500

— 602

1	2	3	4	5	6	7	8	9	10	11
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FIG. 6 600

— 702

1	2	3	4	5	6	7	8	9	10	11
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FIG. 7 700

Docket No.  
2204/184

# Declaration and Power of Attorney For Patent Application

## English Language Declaration

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

**SYSTEM, DEVICE, AND METHOD FOR DISTRIBUTING LINK STATE INFORMATION IN A COMMUNICATION NETWORK**

the specification of which

(check one)

☒ is attached hereto.

☐ was filed on \_\_\_\_\_ as United States Application No. or PCT International Application Number \_\_\_\_\_ and was amended on \_\_\_\_\_ (if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d) or Section 365(b) of any foreign application(s) for patent or inventor's certificate, or Section 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate or PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)			Priority Not Claimed
_____	_____	_____	<input type="checkbox"/>
(Number)	(Country)	(Day/Month/Year Filed)	
_____	_____	_____	<input type="checkbox"/>
(Number)	(Country)	(Day/Month/Year Filed)	
_____	_____	_____	<input type="checkbox"/>
(Number)	(Country)	(Day/Month/Year Filed)	

I hereby claim the benefit under 35 U.S.C. Section 119(e) of any United States provisional application(s) listed below:

\_\_\_\_\_  
(Application Serial No.)

\_\_\_\_\_  
(Filing Date)

\_\_\_\_\_  
(Application Serial No.)

\_\_\_\_\_  
(Filing Date)

\_\_\_\_\_  
(Application Serial No.)

\_\_\_\_\_  
(Filing Date)

I hereby claim the benefit under 35 U. S. C. Section 120 of any United States application(s), or Section 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. Section 112, I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, C. F. R., Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application:

\_\_\_\_\_  
(Application Serial No.)

\_\_\_\_\_  
(Filing Date)

\_\_\_\_\_  
(Status)  
(patented, pending, abandoned)

\_\_\_\_\_  
(Application Serial No.)

\_\_\_\_\_  
(Filing Date)

\_\_\_\_\_  
(Status)  
(patented, pending, abandoned)

\_\_\_\_\_  
(Application Serial No.)

\_\_\_\_\_  
(Filing Date)

\_\_\_\_\_  
(Status)  
(patented, pending, abandoned)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. *(list name and registration number)*

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